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Nanostructured Copper by GLAD for Non-Enzymatic L-Lactic Acid Sensors

•*A. V. Alzate-García[1,2,3], E.F. Agudelo-Chacón [1], S. Mendoza-Rincón[1], N. Prieto[1,2], Y. García[1], E. Restrepo-Parra[1]*

•*[1]Grupo de investigación del Laboratorio de Física del Plasma (LAFIP). Universidad Nacional de Colombia-Sede Manizales, Colombia*

•*[2]Grupo de investigación en cromatografía y técnicas afines (GICTA). Facultad de Ciencias Exactas y Naturales. Universidad de Caldas, Colombia.*

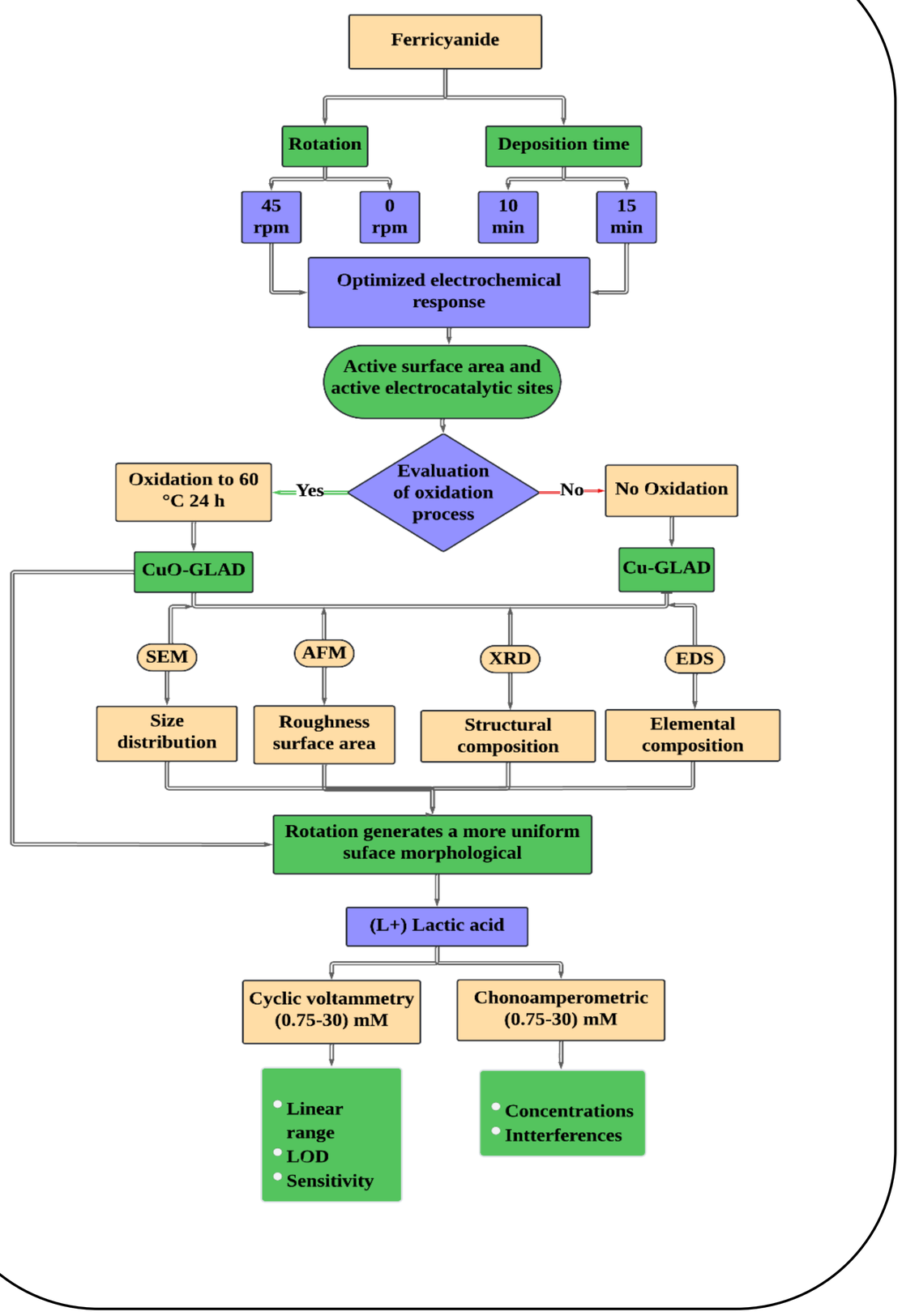
•*[3]Facultad de Ciencias e Ingeniería. Universidad de Manizales, Colombia*

INTRODUCTION & AIM

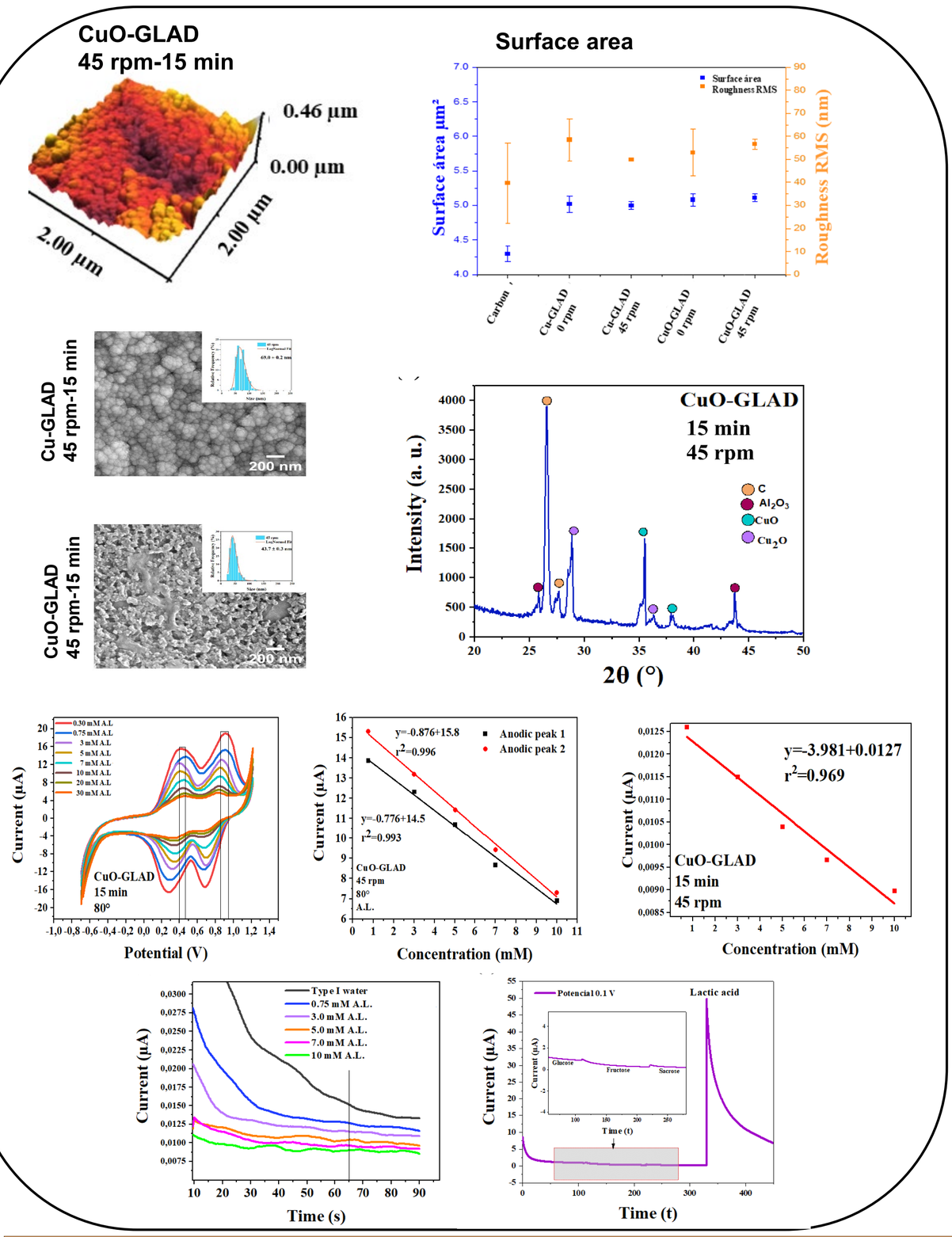
Abstract: This study presents the development of a non-enzymatic sensor for detecting L-lactic acid, whose working electrode was modified with copper nanostructures manufactured using magnetron sputtering and grazing-angle deposition (GLAD) techniques. This coating technique allows porous nanostructures with a high surface area to be obtained, which significantly improves the sensitivity and selectivity of the sensor towards L-lactic acid.

Keywords: Non-enzymatic sensor, L-lactic acid, nanostructures, grazing-angle deposition (GLAD).

METHOD



RESULTS & DISCUSSION



CONCLUSION

1. The GLAD technique enabled the deposition of CuO nanostructured coatings on screen-printed carbon electrodes, producing more homogeneous and porous surfaces with a 40% reduction in nanostructure size and a 16.3% increase in surface area, as measured by AFM and SEM. These morphological improvements increased the density of p sites and facilitated electron transfer, resulting in a stronger and more stable electrochemical signal.

2. The formation of crystalline CuO and Cu_2O phases, confirmed by XRD, demonstrated a chemically pure and structurally stable coating, which promoted efficient Cu(II)/Cu(I) redox transitions. This dual-phase composition enhanced the electrocatalytic activity toward lactic acid oxidation.

3. Electrochemical evaluation using the Randles–Ševčík equation revealed a 11.1% increase in electroactive area under optimal conditions (45 rpm, 80°, 15 min). This improvement translated into a sensitivity of 3.981 µA/mM (≈0.358 µA/ppm) and a limit of Detection (LOD) of 0.56 µM (~0.05 ppm) within a linear range of 0.75–10 mM (≈67.5–900 ppm), confirming the sensor's high analytical performance.

4. The CuO-GLAD sensor exhibited an inverse linear response to lactic acid concentration and high selectivity against common interferents such as glucose, fructose, and sucrose, validating its accuracy, reproducibility, and applicability in biological matrices

FUTURE WORK / REFERENCES

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